Attachment No. 1

APPENDIX A
STATEMENT OF WORK

"Distributed Wind Turbine Competitiveness Improvement Project
Certification Testing (≤200m^2 RSA) – Round 5"

March 13, 2017

1.0 BACKGROUND

The U.S. Department of Energy (DOE) Energy Efficiency and Renewable Energy (EERE) Wind Energy Technologies Office (WETO) defines distributed wind (DW) in terms of technology application based on a wind project's location relative to end-use and power-distribution infrastructure, rather than on technology size or project size; thus, the distributed wind market includes turbines and projects of many sizes. Wind systems are characterized as distributed based on the following criteria:

- Proximity to end-use: wind turbines installed at or near the point of end-use for the purposes of meeting onsite load or supporting the operation of the local (distribution or micro) grid.
- Point of interconnection: wind turbines connected on the customer side of the meter or directly to the local grid.

At the smaller end of the DW spectrum, the small wind[1] industry in the United States (U.S.) has historically been a leader in the international market. Progress has been made in improving consumer confidence in the products through the creation of the Small Wind Certification Council (SWCC) that is responsible for certifying small wind turbines to the requirements of the American Wind Energy Association's (AWEA) Small Wind Turbine Performance and Safety Standard[2]. Other organizations certify small wind turbines to this standard. Nine small wind turbines have been fully certified by the SWCC, and six have been fully certified by Intertek.

NREL is positioned to support U.S. small and midsize wind turbine manufacturers that demonstrate a strong commitment to improving their ability to compete in the global distributed wind market space. Wind technology expertise available at NREL's National Wind Technology Center (NWTC) has been instrumental in the past in supporting technology improvements.

Through NREL, WETO sponsors a multifaceted wind energy research portfolio to assist the U.S. wind industry to develop competitive, high-performance technology for global energy markets. One specific program objective is to increase the number of certified small and midsize wind systems and reduce the levelized cost of energy (LCOE) of turbines used in distributed electricity systems to be competitive with retail electricity rates. "The Distributed Wind Turbine Competitiveness Improvement Project (CIP) Certification Testing – Round 5" is intended to contribute to these program objectives and increase the cost competitiveness of U.S. small and midsize wind turbine manufacturers in the global distributed energy market.

[1] The US DOE defines small wind as 100kW or less. Applicable standards for turbine certification testing will be dependent on the rotor swept area (RSA) of the turbine. IEC 61400-2 applies to turbine ≤200m^2 RSA. The AWEA Standard is consistent with IEC 61400-2 size limitation. Turbines greater than 200m^2 RSA must comply with IEC 61400-1, -12, -23, and any other applicable standards.
[2] http://www.awea.org/Issues/Content.aspx?ItemNumber=4639

2.0 OBJECTIVE

The objective of the CIP is to expand U.S. leadership in the domestic and international distributed wind turbine market sector by assisting U.S. manufacturers in either lowering the LCOE of wind turbines through component improvements and manufacturing process upgrades or obtaining certification for their wind turbines. An increase in the number of certified distributed wind turbines available for the U.S. market is another key objective. Although DW is not defined by size, for this solicitation the turbine size will be capped at $\leq 200 m^2$ RSA.

3.0 SCOPE OF WORK

Under this CIP, the Subcontractor shall conduct work focused on certification testing for turbines with rotor swept areas of $\leq 200 m^2$. The work effort shall include all activities necessary to 1) complete a turbine design review; 2) conduct turbine certification testing to the IEC 61400-2 or AWEA 9.1 standard, or both; and, 3) ensure the turbine is certified. The Subcontractor may also include work to list the turbine assembly to UL standards including controls, inverter and turbine subcomponents. Standards that do not apply in the U.S. will not be covered by this subcontract.

4.0 TASKS

The Subcontractor shall perform the work, comply with the technical requirements, conduct the meetings, and deliver the work products described herein, as minimum requirements.

Certification Testing consists of three key stages: Design Review, Certification Testing, and Turbine Certification. NREL will make a go/no-go determination depending on the outcome of the Design Review. Specifically, based on a detailed design review, NREL shall make a determination on whether the turbine under consideration is likely to meet the design criteria for certification.

All turbine designs are eligible for consideration in this effort. The Subcontractor shall propose to conduct certification testing to the standards that are appropriate for the size of the turbine that is being tested and the certification that is being pursued. Certification testing must be done at a site approved by a qualified certifying body such that the test results shall be accepted. At the conclusion of the certification testing, all certification test reports shall be posted on NREL's Web site.

Task 4.1: Communications:

The Subcontractor shall provide information to and engage in scheduled communications with the NREL Technical Monitor throughout the subcontract period of performance to include:

1) A summary of the contracted effort, void of business sensitive information, with the following information:
    a. Company name
    b. Company contact/Principal Investigator
    c. Project Title
    d. Approximate Start date/duration
    e. Estimated Project Budget
    f. Statement of Problem
    g. Proposed Solution
    h. Project Deliverables and Milestones
    i. Work to be performed
    j. Anticipated Benefits
    k. Collaborating Entities

2) Information on the work effort suitable for inclusion in NREL and DOE news articles, to include high-resolution photos relevant to the effort for inclusion in NREL's photo database and for public dissemination;

3) Participation in monthly conference calls with the NREL team; and,
4) Hosting site visits for DOE and NREL to discuss the subcontract work effort.

Task 4.2: Design Review:

For turbines less than or equal to 200m^2 swept area and certifying under the AWEA 9.1 standard or under IEC 61400-2, a design review shall be completed. Per the Subcontractor's choice, this review may be conducted by NREL or by another independent credible service provider. A credible service provider shall have demonstrated an ability to perform a design review. If the design review is conducted by a third party, NREL shall conduct an audit of the design review. In addition, NREL may request some or all of the analysis and documentation from the design review conducted by the service provider in order to conduct an audit of the work.

Based on the design review, NREL shall determine whether the turbine is ready for certification testing. The intent of this review is to ensure that the turbine to be tested is likely to pass the structural design review so funding is not expended on testing a turbine that cannot be certified as designed. This is essentially a preliminary version of the Limit State Analysis (Task 4.4 below). Refer to IEC 61400-2 for details on the information and analysis required. For turbine configurations that do not qualify to use the simplified loads model and for which there are no approved aeroelastic models, the subcontractor shall provide other means of loads development. The other means shall be well documented and sufficiently detailed to allow review of the loads derivation approach and results. While this offering is configuration agnostic, all subcontractors must show capability to develop loads that NREL can be confident are reasonable and based on sound engineering.

Task 4.3: Turbine System Commissioning and Acceptance:

After the successful installation of the turbine system, the Subcontractor shall complete the commissioning tests of the turbine system jointly with the test facility and/or certifying body, to ensure manufacturing quality, proper assembly, and absence of observable material defects and to verify functionality, safety, and performance characteristics, utilizing the commissioning checklist, to include equipment inspections, quality assurance checks, and acceptance tests that are typically required by the turbine system manufacturer. Typical commissioning activities include inspections and checkout of the turbine system operating characteristics. A letter report documenting the installation and commissioning shall be submitted to NREL. The letter report shall include documentation of approval to begin testing by the test facility or certifying body. If the loads for certification will be derived based on loads measurements, then the installation and calibration of the loads measurement system shall be included in this task.

Task 4.4: Design Load Derivation and Limit State Analysis (Strength Evaluation):

The Subcontractor shall submit a copy of the design load document identifying the method that was used and the design loads that resulted from it. Additionally, the Subcontractor shall submit a copy of the design documentation containing the limit state analysis (this should include ultimate and fatigue strength analysis as well a critical deflection analysis) of key components, following the standard that is being used for certification.

Task 4.5: Certification and certification process evaluation:

The Subcontractor shall develop a letter report summarizing the certification process, highlighting any obstacles that were encountered and lessons learned. Copies of the final certification test reports, including Power Performance, Safety and Function, Acoustics, and Duration, shall be submitted with the letter report, along with copies of any certificates obtained through the subcontracted efforts. The certification test reports will be posted on the NREL Web site.

5.0 REVIEW MEETINGS AND TRAVEL REQUIREMENTS

The Subcontractor may, but is not required to, travel to NREL one or more times to discuss the review of the design evaluation or other technical support from NREL. Conference calls and or in-person meetings will be conducted over the course of the subcontract period of performance, and shall be scheduled by either the Subcontractor or the Technical Monitor on an as-needed basis and as mutually agreed to.

6.0 DELIVERABLES

The Subcontractor shall provide the following deliverables:

6.1 The Subcontractor shall submit a summary of the contracted effort, void of business sensitive information, as described in Task 4.1. **Due: one (1) month from date of subcontract execution**.

6.2 Dependent on who conducts the design review, the Subcontractor shall submit the following: either the documentation necessary to conduct a design review (if NREL is to conduct) or a copy of the design evaluation review report for review by NREL (if Subcontractor elects to utilize another credible service provider) as defined in Task 4.2. Documentation shall include: loads analysis calculations based on approach used for determining limit loads, structural analysis that demonstrates the structural design complies with minimum safety factors, and any other information that NREL needs to conduct a review of the turbine design. NREL may require sufficient detail for any load derivation that they can replicate the results obtained by the subcontractor and verify that the approach is based on sound engineering. Any data that are considered proprietary must be indicated at the time the data are provided in a manner consistent with the contract terms. The Subcontractor shall provide authorization for the design review provider to answer any questions from NREL on the review conducted for the Subcontractor. Due**: two (2) months from date of subcontract execution**

6.3 The Subcontractor shall submit a letter report documenting the successful installation of the turbine and the signed Commissioning report as defined in Task 4.3. **Due: four (4) months from date of subcontract execution**

6.4 The Subcontractor shall submit a copy of the design load document identifying the method that was used and the design loads that resulted from it as well as a copy of the design documentation containing the limit state analysis, as defined in Task 4.4. Any data that are considered proprietary must be indicated at the time the data are provided in a manner consistent with the subcontract terms. **Due: four (4) months from date of subcontract execution**

6.5 The Subcontractor shall submit a letter report highlighting any obstacles that were encountered and lessons learned during the certification process. Copies of all final certification test reports and the resultant certificates, as defined in Task 4.5, shall be submitted to NREL along with the letter report. **Due: nineteen (19) months from date of subcontract execution**

6.6 Quarterly Reports: The Subcontractor shall provide quarterly reports to include a description of work performed by the Subcontractor. The report shall describe the status, explain variances and problems, report on accomplishments, and explain progress expected in the next quarter. **Due: Quarterly from execution of award**.

DELIVERY OF COMPUTER SOFTWARE CODE (AS APPLICABLE)

All object, source, or other code (including all applicable data sets) developed under this subcontract effort shall be provided to the technical monitor as a condition of final payment, in accordance with the subcontract. It is expected that all delivered source code shall be original and the subcontractor shall provide a written certification to the subcontract associate that all source, or other code developed and delivered under this subcontract does not contain any open source code - as a condition of final payment in accordance with the subcontract. The subcontractor's (including all lower tier subcontractors, as applicable) certification shall specify that "All source, or other software code developed and/or delivered under this Subcontract No._____ is original and does not contain any 3rd party or other open source software."

7.0 ELECTRONIC REPORTING REQUIREMENTS FOR SUBCONTRACT REPORT DELIVERABLES

It is NREL's intention to publish subcontract report deliverables containing publicly available information (e.g. non-confidential, non-protected, non-proprietary information) for distribution on the internet.

The subcontractor shall provide the final approved version of report deliverables in accordance with the electronic reporting requirements described below.

The technical monitor may specifically direct the subcontractor to provide reports in one or more of the file format standards provided below.

a. The subcontractor shall submit all report deliverables (including status, annual, or final reports) as electronic files in Adobe .pdf format, preferably with all graphics and images embedded within the document.

b. All final approved version submissions shall be delivered to NREL via e-mail to the 1) NREL Technical Monitor, 2) the NREL Subcontract Administrator or Associate (as specified in the Deliverable Addresses below).

c. If it is not possible to include all of the graphics and images (figures, illustrations, and photographs) in the same file as the text, NREL will accept the text in Adobe .pdf formats and the graphics and images as separate electronic graphic or image files*. The accepted standard for page layout and graphics is the Adobe Creative Suite of programs.

   *The acceptable graphic or image file formats are: .eps, .tif, .gif, .jpg, .wmf, .emf, .pct, .png, .bmp, .psd, .ai, .fh, .qif, .fpx, cdr. The preferred resolution for graphics or images is 300 dpi. Include all fonts used in creating the file.

d. For animation, video, or multi-media elements, CD-ROM, DVR and thumb drive are acceptable technical deliverable media.

e. For all calculations in support of subcontract reports that are conducted in ASPEN+, an electronic copy of INPUT, REPORT and BACKUP (if Model Manager is used) must be submitted with all reports. Additionally, if costing or sizing calculations are conducted in a spreadsheet [no process calculations (heat and material balances) in spreadsheet format are permitted], a copy of the fully documented MS Excel file shall be supplied.

f. A fully executed model release shall be supplied to NREL with all photographs and images, regardless of whether such photographs or images are delivered to NREL electronically or in hard copy. Such model release shall certify that the Alliance for Sustainable Energy, LLC, Management and Operating Contractor for the National Renewable Energy Laboratory for the U.S. Department of Energy is granted a non-exclusive, paid-up, irrevocable, worldwide license to publish such photographs in any medium or reproduce such photographs or allow others to do so for United States Government purposes. Model releases are required in all situations in which a reasonable person would respond in the affirmative to the question – could someone, other than the model himself/herself, recognize the person in this photograph

or image? All model releases shall be provided to the subcontract associate as a condition of final payment, in accordance with the subcontract. To obtain a Subcontractor Model Release form, please contact images@nrel.gov.

8.0 ACKNOWLEDGEMENTS IN SUBCONTRACTOR PUBLICATIONS

In any scientific or technical report or article, conference paper, journal article, etc. based on or containing data first produced in the performance of this subcontract and published in academic, technical or professional journals, symposia proceedings or similar works, the subcontractor shall use this acknowledgement stating, "This [article, conference paper, journal article, etc.] was developed based upon funding from the Alliance for Sustainable Energy, LLC, Managing and Operating Contractor for the National Renewable Energy Laboratory for the U.S. Department of Energy."

9.0 COPYRIGHT PERMISSION/AUTHORIZATIONS

The subcontractor is responsible for obtaining copyright permissions and/or authorizations for all information and/or data, as applicable that is incorporated into all final technical reports. Electronic copies of these copyright permissions and/or authorizations shall be provided to the subcontract associate at the email address provided below. The subcontractor shall also provide a written certification to the subcontract associate as to such permissions and/or authorizations as a condition of final payment. The subcontractor's (including all lower tier subcontractors, as applicable) certification shall specify that "I have obtained all necessary and legally required copyright permissions and/or authorizations for any and all information, data, graphs, images, etc., as applicable, that is incorporated into the final Technical Report titled _____, delivered under this Subcontract No._____. Copies of these permissions and/or authorizations are attached."

Deliverable Addresses:

The subcontractor shall clearly label all deliverables to include:

- The subcontractor's name
- NREL's subcontract number
- NREL Technical Monitor's name
- Deliverable date, and
- Deliverable description.

Deliverables shall be sent via email to each of the following addresses:

1) **, Technical Monitor
National Renewable Energy Laboratory
15013 Denver West Parkway
Golden, CO 80401
e-mail: **

    - One (1) master electronic version, including graphics

2) **, Subcontract Associate
National Renewable Energy Laboratory
15013 Denver West Parkway
Contracts and Business Services
Golden, CO 80401
e-mail: **

    - One (1) master electronic version, including graphics